Chapter 27

Paleontological Case Study

The Pit of the Bones

Research on human origins is often called **paleoanthropology**. Once conducted by a few people searching for hominid fossil bones, investigations into human origins and evolution now involve large, multidisciplinary, often international teams of field and laboratory specialists who seek to reveal the past in a detail thought impossible only two decades ago. In today's paleoanthropological projects, paleontologists specializing in various plant and animal groups ranging from pollen to elephants are integrated with physical anthropologists, archaeologists, geologists, geochronologists, and remote sensing specialists. The present case study involves the most significant hominid discovery ever made in Europe, a discovery which is rewriting the textbooks of human evolution.

In 1856 a partial skeleton was recovered from a cave in the Neander valley near Dusseldorf in Germany. Recognized by their peculiar skeletal and cranial features, many more Neanderthals have since been found in Europe and the Middle East. *Homo neanderthalensis* is now a widely accepted side branch in the human evolutionary tree. But from where did this form come? When, where, and how did it evolve its anatomical peculiarities? For years, paleoanthropologists posed these and many other questions. Answers came slowly, fragment by fragment, as bits of crania, mandible, and postcrania were revealed at sites such as La Chapelle, Le Moustier, Heidelberg, and Swanscombe. Discoveries at a series of sites in northern Spain, collectively known as Atapuerca, have recently shaken European paleoanthropology. This research is ongoing, but the spectacular finds made by teams of paleoanthropologists working to reveal the Pleistocene Europeans are revolutionizing our views of these ancestors and relatives. This case study is about the most impressive set of Atapuerca discoveries, that of the skeletal remains of over 30 individuals found deep in a cave system, in a small cavity known as the Sima de los Huesos, the Pit of the Bones (Arsuaga et al., 1997). This work involves building knowledge of the past through applying the principles of skeletal identification and analysis stressed in previous chapters. Like most osteological work, it involves many steps, illustrated in Figure 27.1.

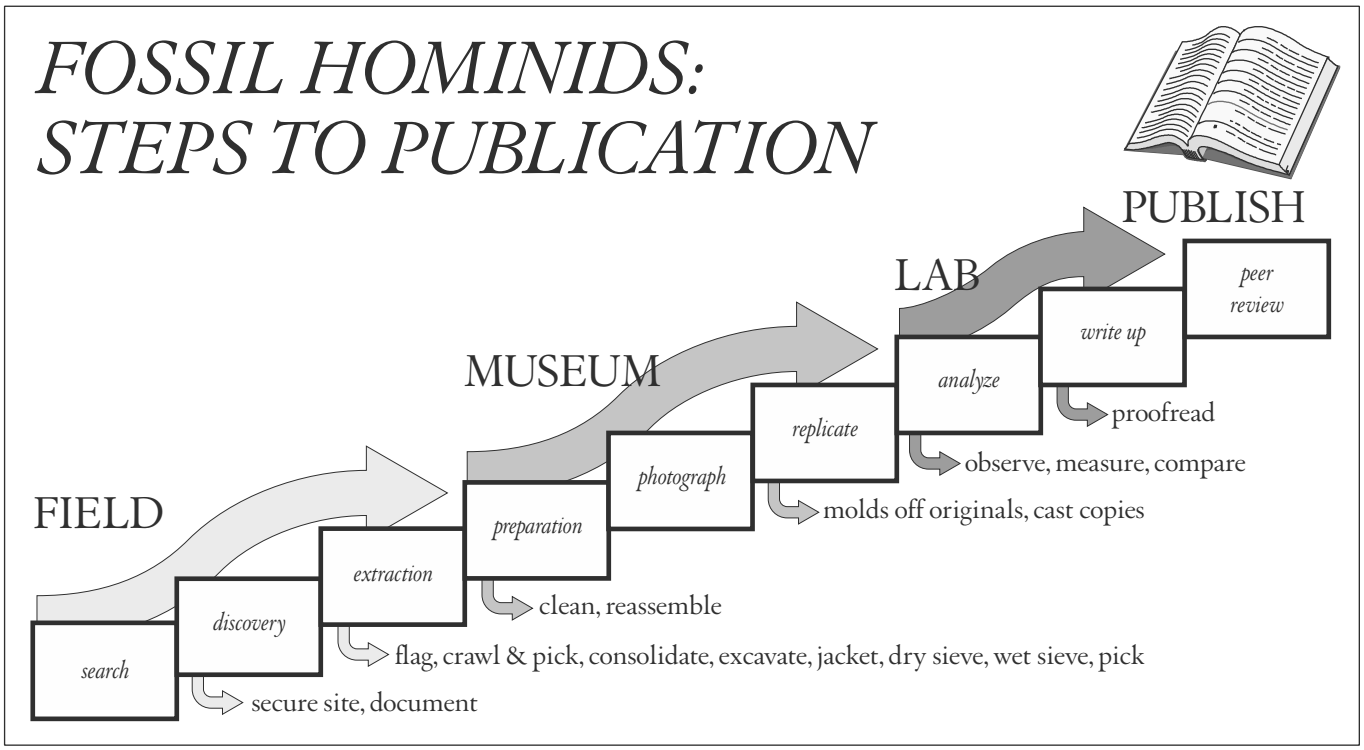

Figure 27.1 **The process to publication.** Bioarchaeological and paleoanthropological research proceeds through a series of steps that intervene between project conception and publication. Depending on the nature of the fieldwork and laboratory analysis, such work can take large teams of specialists decades to complete.

27.1 Atapuerca

The Sierra de Atapuerca is 12 km northeast of the historic city of Burgos, in the northern part of Spain. The hills here feature a variety of karst systems, including extensive cave systems, sinkholes, and collapsed caves in upper Cretaceous marine rocks. The cutting of a deep and narrow trench for a former railway exposed some of these caves and their fillings. Excavations in the Gran Dolina, one of the cave fillings exposed in the wall of the railway cut at Atapuerca, recently yielded the earliest dated hominid remains from Europe, ca. 800,000-year-old remains that show evidence of cannibalism. The younger Sima de los Huesos is found close by, across the railroad trench, opposite the Gran Dolina.

To get to the Sima today, one enters the Cueva Major-Cueva del Silo system about 500 m away. To reach the Pit of the Bones one must descend into the cave system and traverse a labyrinth of angular, tortuous, mazelike passages. Sometimes stooping, sometimes walking crablike, and often crawling and sliding through tiny openings, one passes 500 m through the dark, silent, and always muddy passages and galleries of this cold subterranean complex. Getting to the Sima and back out is physically exhausting. Near the end of the approach, the cave system opens up into the colossal Cyclops Gallery (Figure 27.2), with a narrow passageway leading into the Sala de las Oseras (the bear-nest chamber), where bear hibernation nests and claw marks are found in the clay adhering to the chamber's walls. Excavations there revealed bears who died during hibernation. In the opinion of the researchers, there was probably a small entrance to the cave system near the Cyclops Gallery that allowed bears to get into this part of the cave system to hibernate. Humans apparently only came here once, or a few times, because no archaeological remains are present,

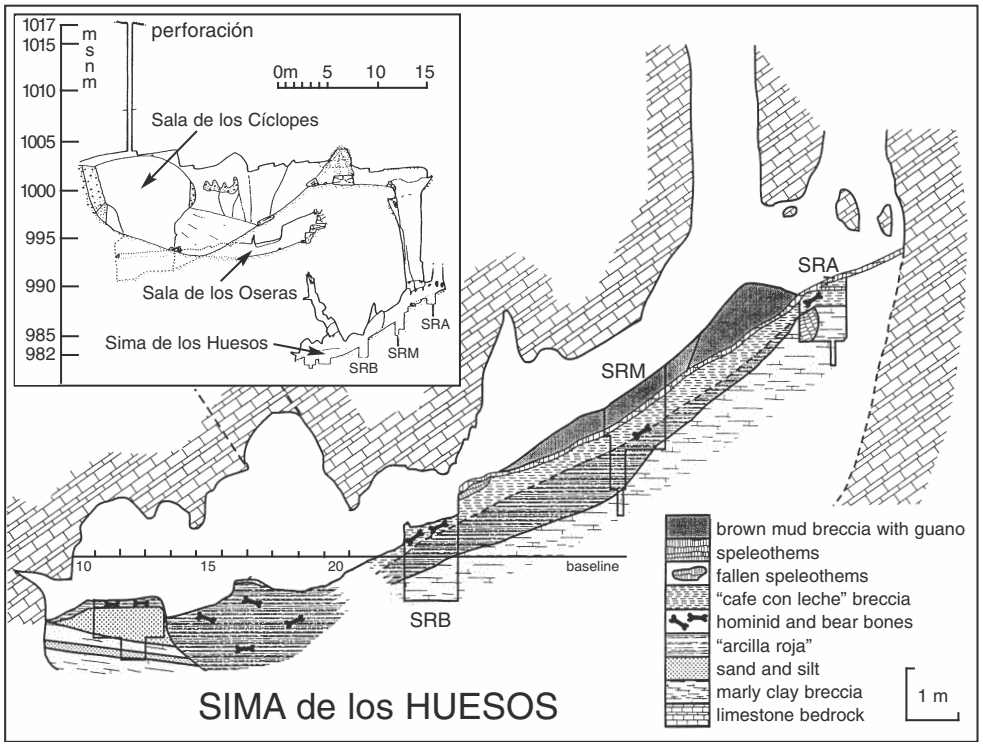

Figure 27.2 **Geological sections**. Profiles of the Cyclops Gallery and the Sima de los Huesos. From Arsuaga et al. (1997).

and this entrance to the cave system was blocked by a cave collapse in the Middle Pleistocene and sealed.

Today, after traversing the Cyclops Gallery, one passes down a steeply sloping, 2-m-wide passageway leading to a vertical shaft which connects to the Sima below. The only entrance to the Sima is through this vertical shaft. With climbing safety ropes attached, one descends slowly down a narrow ladder into the cavity below (Figure 27.3), reaching an inclined surface known as La Rampa, the ramp. The Sima de los Huesos is the small cavern at the foot of the ramp.

27.2 Discovery

The first hominid fossils from the Sima were found in 1976 during a sampling of its bones by a graduate student of Professor E. Aguirre of Madrid. The sediments of the Sima had been badly disturbed by amateur collectors attracted by the abundant bear bones. A small sample of the disturbed sediment was collected during a brief 1983 visit by Aguirre's team. It yielded three additional hominid teeth among the bear bones. In 1984 the systematic removal of the Sima's disturbed sediment began and the first fossils were found *in situ*. In those days the Sima was choked with disturbed sediment, bones, and fallen limestone blocks.

Figure 27.3 **Descending into the pit**. Team leader Arsuaga climbs down the 13 meter chimney into the Sima de los Huesos. Photo by and courtesy of Javier Trueba.

27.3 Recovery

In order to reach the *in situ* remains, the overlying mass of debris and disturbed sediments had to be cleared. Large blocks were broken by hammer and chisel. Everything was removed and pulled up through the shaft. Only a few workers could work in the Sima at one time, and oxygen was rapidly exhausted because there was no ventilation. All the disturbed sediment, several tons worth, was removed in the backpacks of workers who climbed out of the pit and snaked their way back to the surface with their precious cargo (Figure 27.4). The sediment was taken to a nearby river where it was wet-sieved to recover the fragmented remains of hundreds of bears and the few hominid remains.

Figure 27.4 **The Sima de los Huesos team at the entrance of the Cueva Major**. During the field season these workers crawl through 500 m of narrow passageways and cave galleries each day as they descend into the cold, dark, Pit of the Bones. The team leader, Juan Luis Arsuaga, is centered in the back row. Photo by and courtesy of Javier Trueba, from Arsuaga et al. (1997).

Most of the bones were broken, some of them into many dozens of pieces. The resulting mixture of mostly bear and hominid remains was sorted piece by piece, first by taxon and then element. The slow and tedious job of restoration proceeded simultaneously. It took over five years to remove the uppermost disturbed sediments from the cave, but the hominid count climbed. In 1987 a suspended scaffolding was installed in the Sima to allow the paleontologists to work without stepping on the newly exposed, *in situ* sediment (Figure 27.5). A shaft was drilled through the roof of the Cyclops Gallery to allow a more direct removal of sediment.

As the *in situ* deposit was excavated, it was found to contain a bone-bearing breccia with clay matrix, mainly composed of *Ursus deningeri.* This Middle Pleistocene bear was the ancestor of the larger, later Pleistocene cave bear. By the end of the 1995 season, a minimum number of 166 bear individuals was calculated from the thousands of bear bones recovered from the excavations. A total of 1685 hominid pieces had been found to represent a minimum number of 32 hominid individuals. Every part of the hominid skeleton was represented, often by many individuals. A

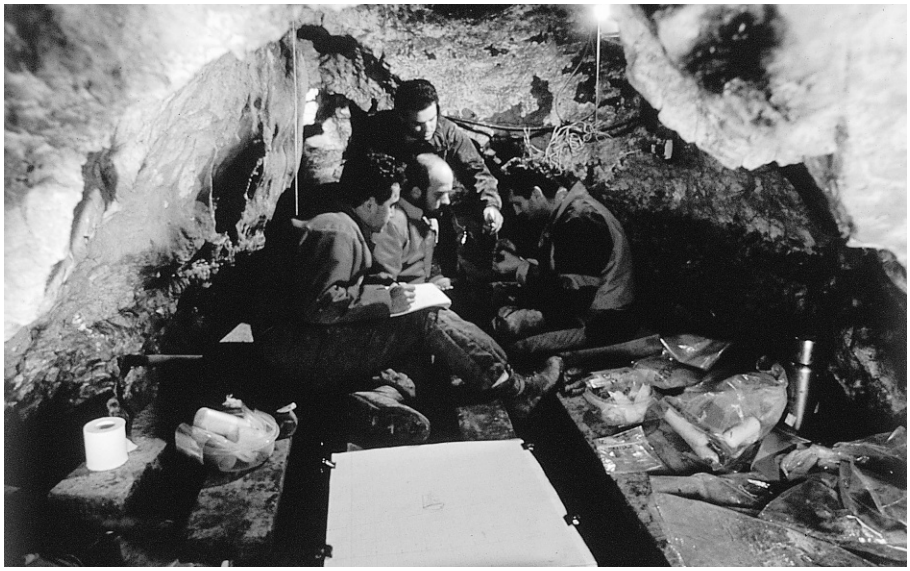

Figure 27.5 **The Sima de los Huesos team at work, deep in the pit**. They are working on a suspended scaffold which protects the unexcavated, fragile fossils beneath them. Photo by and courtesy of Javier Trueba.

few other carnivores and micromammals were found, but no ungulates and no archaeological remains. None of the hominid bones were found in articulation, but there are some significant associations. For instance, Cranium 5 and its mandible were found together, as were two hip bones and sacrum of the complete pelvis and many bones of the same hand. Almost all of the bones in the deposit were broken, and restorations and individual associations were difficult to perform.

Excavation of the *in situ* remains had to proceed very slowly because of the logistical conditions and the fragility of the specimens. The bones were extremely soft and fragile, and wooden implements were used to slowly remove the wet clay in which they were embedded. Careful application of preservative was required for each piece. In some parts of the deposit, there was more bone than matrix (Figure 27.6). Only a small part of the Sima deposit has so far been excavated, and it is certain that many more hominid fossils will be recovered. Dating efforts are continuing, but it is clear from biochronologic and radioisotopic considerations that the site is probably greater than 300,000 years old. Already, however, this assemblage is staggering in its size and importance — Atapuerca's Sima de los Huesos is already the largest known repository of fossil hominids from the Middle Pleistocene and a tremendous source of knowledge about the skeletal biology of a hominid population from the deep past.

Figure 27.6 **A portion of the hominid fossil breccia during the 1992 excavation**. All of the pieces are hominid, except for a bear's rib fragment at the top center. Multiple crania, a mandible, and postcranial elements are visible. The bones are very soft and delicate at this stage of extraction, and can only be extracted, handled, and studied after preservative is applied. Anatomical detail is excellent. Photo by and courtesy of Javier Trueba, from Arsuaga et al. (1997).

27.4 Paleodemography

After the tens of thousands of bear bones had been segregated from the ca. 1600 hominid pieces, and after a massive refitting exercise joined as many of the bones from the ever-growing sample as was possible (Figure 27.7), it was necessary to estimate the minimum number of hominid individuals that had been recovered so far. This was done by Bermúdez de Castro and colleagues, working on the mandibular, maxillary and dental remains. A minimum of 32 individuals were represented, and of these, a balanced sex ratio was calculated (Figure 27.8). Age at death was estimated by applying the Miles method described in Section 18.4.2. The resulting survivorship curve showed low representation of infants and children, and a high representation of adolescents and prime-age adults.

27.5 Paleopathology

Analysis of the hominid sample showed that it was characterized by a high incidence of temporomandibular joint disease. Signs of this pathology were found in 70% of individuals, well above values seen in historic populations. One skull showed an extensive maxillary osteitis associated with a dental apical abscess, and another apical abscess in its mandible. There were no fractures or clear traumatic lesions among 1200 postcranial elements, but one immature individual showed a severe traumatic lesion on its left browridge. Enamel hypoplasias were present, and most commonly emplaced between birth and seven years. There were significantly fewer hypoplasias than are found in either Neanderthals or most modern human populations.

Figure 27.7 **Work in progress**. Arsuaga stands behind the tabletop of hominid bones recovered from the Sima. Analysis of this large sample could only begin after a meticulous excavation, careful cleaning and preservation, and a full sorting, identification, and refitting. This is only a fraction of the hominid sample that will eventually come from the Pit of the Bones, but it is already the largest and most significant fossil hominid assemblage ever found. Each summer's excavation increases the size of the sample. Photo by and courtesy of Javier Trueba.

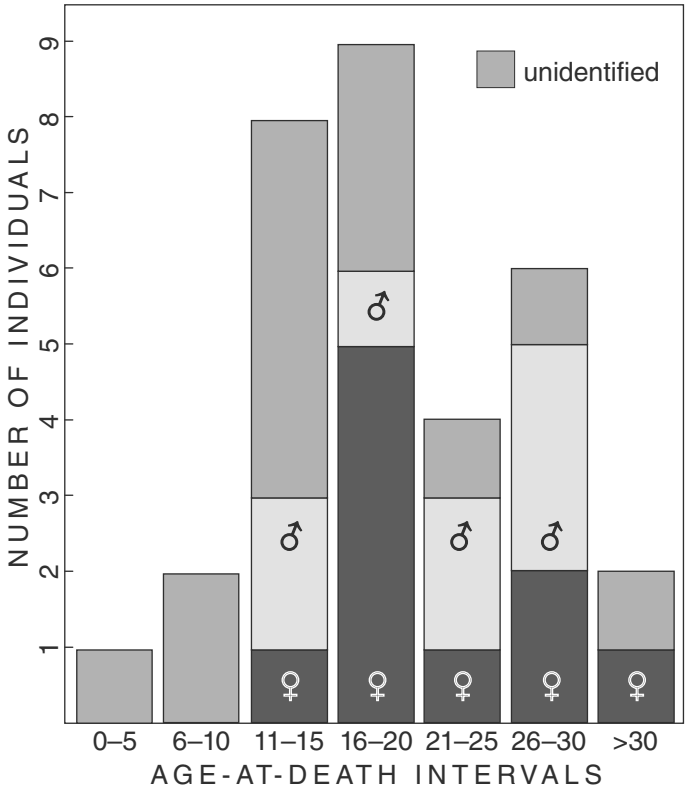

Figure 27.8 **Age profile**. Age-at-death distribution of the 32 individuals identified in the Atapuerca Sima de los Huesos fossil hominid assemblage. Sexes are differentiated here where determination was possible. From Arsuaga et al. (1997).

27.6 Functional and Phylogenetic Assessment

The skeletal remains from the Sima, because of their excellent preservation and completeness, and because of the large number of individuals, allow for considerations not often available to paleoanthropologists. For example, it is evident that the sexual dimorphism in these hominids was no greater than that seen among modern human populations. It is evident that not all of the peculiar morphological characters defining later Neanderthals had yet evolved in the Sima people. However, a set of traits uniting these Middle and Late Pleistocene forms was detected. For example, the Sima hominids, and the Neanderthals that followed them, share a more laterally oriented scapular glenoid cavity than any other hominid, a transversely oval humeral head, and a host of characters of the occipital, frontal, and facial skeleton. These novel traits, characters shared exclusively between the two hominid forms, suggest to the Atapuerca team that they have discovered the exclusive ancestors of Neanderthals. This interpretation would mean that European populations had a distinct evolutionary role for hundreds of thousands of years. Such findings lead the Atapuerca team to predict that the ancestry of anatomically modern humans will not be found in European fossils but perhaps in Asian or African contemporaries of the Sima people.

27.7 Continuing Mysteries

The fossil hominids from the Pit of the Bones, and the still larger sample that lies entombed within the Pit, will keep paleoanthropologists busy for decades, if not centuries. All these remains will come under the scrutiny of new workers and new techniques. How did this unique collection of fossils come to be deposited in this deep chamber in the first place? This is the central mystery of the Sima de los Huesos. Some facts surrounding the assemblage illustrate the magnitude of solving this puzzle. The demographic profile suggests part of the age pyramid of a living population. Deposition was far from a cave entrance. There are a few rodents, no herbivores, no food refuse, no stone tools, and no human modifications on the bones of either the bears or the hominids (there are some carnivore tooth marks on both). Bears, by far, are the most abundantly represented mammals in the deposit. There is no clear size sorting or alignment of the bones. All elements of the body are represented. The main biases are against sternae, vertebrae, and ribs. No bones are articulated.

Arsuaga and colleagues believe that the Sima was a natural trap for bears in the Middle Pleistocene, and that animals falling into the pit could not climb up the chimney from the pit. They suggest that mortuary practices were responsible for the accumulation of men, women, and children in the Sima. As bears fell into the pit, and desperately struggled in vain to dig their way out, they disarticulated, trampled, unintentionally fractured during digging, and occasionally gnawed other bones already in the Sima. They, in turn, died — only to later become disarticulated, fractured skeletal remains themselves. These remains stayed trapped in the wet, cold mud of the Sima until their scientific rescue began late in the 20th century. It is important to remember that only a small volume of sediments has so far been excavated. It is too early for meaningful studies of spatial distribution to be made, and it is virtually certain that additional element associations will be found. As excavations by this remarkable team of Spanish investigators continue into the next century, more clues to the central mystery of the Sima de los Huesos will continue to bring us closer to a solution and to a better understanding of the deep past.